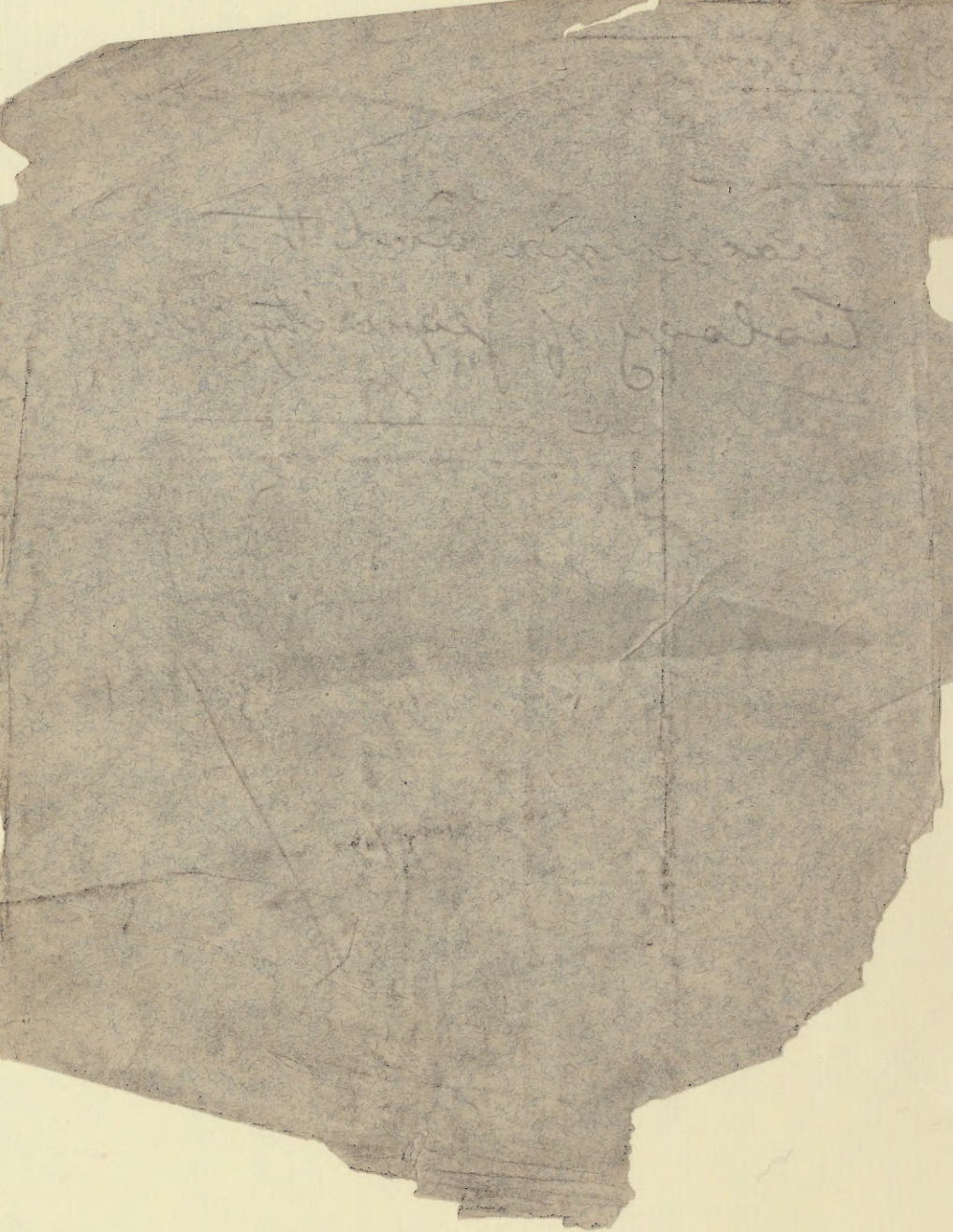


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Trachoma and the
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TRACHOMA AND THE ETIOLOGY OF JEQUIRITY OPHTHALMIA.*

By J. A. ANDREWS, M.D.,

NEW YORK,

MEMBER OF THE AMERICAN OPHTHALMOLOGICAL SOCIETY, OPHTHALMIC SURGEON TO CHARITY
HOSPITAL, ETC.

THE motive for presenting to this society a paper on a disease so common as trachoma, is furnished by two circumstances, *i. e.*, the recent introduction by Dr. de Wecker of Paris of a new therapeutic agent for the treatment of this rebellious affection, and a new view of its etiology advanced by Prof. Sattler of Erlangen.

If we may measure the importance of a disease by the frequency with which it is met in practice, and by the amount of controversy to which it has given rise, then *trachoma* or *granular conjunctivitis* deserves a conspicuous place in medical literature.

Permit me to say, at the outset, that whatever criticisms I may make regarding the histology of the conjunctiva and the tissue changes in granular conjunctivitis, are based upon examinations of eighteen healthy human conjunctivas at ages varying from the time of birth to the thirty-first year, and forty-seven cases of trachoma examined at different periods of the disease during the past six years. The chapter on the *etiology of jequirity* is the out-

* Paper read before the New York County Medical Society, April 28, 1884.

Reprinted from the ARCHIVES OF MEDICINE, Vol. xi., No. 3, June, 1884.

come of experiments made on a large number of rabbits and dogs; and that part of the paper which deals with the *bacterial view of trachoma*, is based upon examination of thirty-seven cases of trachoma with this end in view.

ETIOLOGY.

Granular conjunctivitis is developed most frequently by contagion,—by the transportation of secretion from the eye of a patient with the disease to a healthy eye. Yet, we know that blennorrhœic pus may give rise to granular conjunctivitis in another, although it may never develop in the original eye; and cases of this disease certainly do occur in persons who have never been brought in contact with a patient who is the subject of granular conjunctivitis. Von Græfe maintained that the contagion was transmitted through the atmosphere. This much we do know, that the disease in question does sometimes occur epidemically among individuals living under the same bad hygienic conditions. But just why blennorrhœa will develop in one case into trachoma and not in others is not explained, in fact, by the supposition that the one disease is *bacterial* in its origin and the other not. *The numerous examinations and cultures of blennorrhœic pus have convinced me of the pretty constant presence of a micrococcus, but that there is no morphological or physiological difference between it and the micrococcus found in trachoma pus;* and we are forced to speculate that trachoma is a simple blennorrhœa produced by bad hygiene, which so modifies the organism that the disease assumes a particular condition. To what degree we should regard *diathesis* or congenital predisposition responsible for trachoma is a question of great interest and importance. If a particular bacterium were responsible for the disease,—this bacterium, like that of tuberculosis and typhoid fever, etc., inhabiting the air,—we could still reconcile ourselves to the immunity or rather escape of many individuals from tra-

choma. However, we have, in the idea of the bacterial origin of trachoma, a hypothesis which experimentation alone must prove or disprove.¹ Prof. Sattler, who first announced the discovery of a micrococcus in the trachoma tissue, claims to have succeeded in reproducing the disease with the elements derived from the culture of the parasite, which he considers to be the generator and vehicle of the contagion.

My own investigations are diametrically opposed to Sattler's view. I have succeeded in cultivating in sterilized gelatine bouillon, and blood-serum culture media, a micrococcus variety derived from the trachoma secretion or pus, but I have never been able to reproduce with pure cultures (for we often find many different forms of bacteria in these secretions) a disease resembling trachoma. I have made diligent examinations of over 1,500 sections derived from thirty-seven cases of trachoma—the piece of tissue for examination having been excised during life, and placed at once in strong alcohol, and subsequently embedded in celloidin, and the thinnest sections made with a microtome, and subjected in many cases for a longer time than usual to the action of one of the aniline coloring agents, methyl blue, methyl violet, fuchsine, Vandyke brown, Hoffman's purple, and decolorized with alcohol, or acetic acid, and mounted in glycerine or balsam without chloroform, an Abbe's condenser being used in every instance.

Sattler² acknowledges that micrococci are absent in some cases from the secretion in trachoma at certain periods of its course, when, he says, the secretion is not contagious. He states that from seven to eight days after inoculation of the selected culture medium (blood serum) with secretion from trachoma, there spring up at the site of inoculation a

¹ Bericht über die Versammlung der Ophthal. Gesellschaft, Heidelberg, 1882.

² *L. c.*, p. 173.

few pale, yellowish points; and that he found exactly the same micrococcus in the trachoma tissue as in the secretion. He speaks of the micrococci clinging to the exterior of the nuclei.¹ If these micrococci actually do exist in the trachoma tissue I have never been able to find them. It is so very easy to be mistaken as to the identity of certain bacteria, especially those of the micrococcus tribe. We know how closely micrococci are simulated by nuclear detritus in the blood, by the "Mastzellen" of Ehrlich—a large granular cell found in inflamed tissues—and although these objects may usually be distinguished from micrococci by their rarely being of uniform size as micrococci are, and by their reaction to certain staining agents, yet the positive proof, after all, is usually only furnished by cultivation outside of the body. In examining this question for myself, I proceeded as follows:

After thoroughly washing the conjunctiva of a given case of trachoma with a solution of bichloride of mercury, too weak to destroy micro-organisms after so short an application, this being used only for its mechanical effect to remove all secretion, and because it would not be likely to be itself contaminated with micro-organisms as in case plain water were used. The scissors and forceps were sterilized by heat, and one or more trachoma granules were excised and placed in the sterilized gelatine bouillon, and transferred to the incubator at a temperature of 35° to 36° C. In some instances, despite my precautions, the culture medium was contaminated by a variety of bacteria, but inoculation of rabbits' and dogs' eyes with these failed to produce trachoma. But in a large number of instances the culture medium remained free from bacteria for several weeks, until they were thrown away. However, I am still engaged upon this subject, because I believe it requires further investigation.

¹ "Bericht der Ophthal. Gesellschaft," Heidelberg, 1881, p. 24.

Experiences must be multiplied, and if they conform to one another, then only can we have a true conviction. This fact remains: inoculation with trachomatous pus produces in some cases an acute inflammation, which may disappear without leaving a trace of mischief, or it may give rise to granular conjunctivitis. If there were a specific element you might say it should always reproduce the same disease and not another. But even such an argument would not dispose of the idea of the specific character of the disease in question. As already stated, I have found micrococci in blennorrhœic and trachomatous pus (if I may take the liberty with the term), and there is nothing unusual in this circumstance; but although apparently identical morphologically, I have not succeeded in establishing by cultivation a physiological difference—*i. e.*, in isolating a micrococcus or any other variety of micro-organisms which is capable of producing trachoma; nevertheless, it may exist. And even should Sattler's views be disproved by others, they do not deserve to be ridiculed with criticism based upon hypothetical reasoning. His analyses are evidently honestly meant, and have been fairly conducted, and should be treated in a more liberal spirit than has been accorded to similar views of other writers in connection with other diseases.

It is a curious circumstance that purulent conjunctivitis, and especially blennorrhœa, may give rise to trachoma; and in view of recent developments, or rather contradictions, it would be less hypothetical to maintain the existence of a close relationship between granular conjunctivitis and other forms of conjunctival inflammations; and when we find something special, as in trachoma, to refer this to the individual and not to the disease itself. But in what degree a certain diathesis is responsible for this disease, it is difficult, even in the presence of statistics, to speak with posi-

tiveness. At any rate it is a significant circumstance that the granulations attack by preference individuals the state of whose lymphatic system predisposes them to the production of certain diseased conditions. Trachoma is comparatively rare among those whose means permit them to live under good hygienic conditions, and in healthful climates; and these conditions generally influence trachoma favorably. This, of course, is characteristic of every disease which is due to a mischievous diathesis or deterioration of the organism from whatever cause. The same may perhaps be said respecting the *influence of race*.

Dr. Swan M. Burnett,¹ of Washington, D. C., has directed attention to the immunity of the negro from trachoma. In a letter which I have recently received from this gentleman, he stated that he intended to publish shortly the results of his investigation among negroes in connection with the disease in question. Dr. B. informed me that he had examined one thousand negroes without finding a single example of trachoma among them. But it would be highly important and interesting to investigate the conditions under which these people live. Whatever influence race may exercise there can be little doubt that geographical, or, better perhaps, climatic causes and unfavorable hygienic surroundings play a still greater part in the etiology of this disease. Trachoma has been styled "*the Celtic disease*"; but here, too, we should consider the conditions just alluded to.

Sæmisch² directs attention to the increase in the extent of trachoma along the Rhine, from its source to its mouth. Although this disease ~~is said to~~ almost never originates in Switzerland, we should refer this immunity to the climatic rather than the mountainous condition of the country, because mountainous regions do not furnish any protection against the spread of the affection.

¹ Report of the Fifth International Ophthalmological Congress, 1876.

² Sæmisch und Græfe: Handbuch, Bd. iv, p. 66.

In Southern Russia, Mandelstamm¹ states that trachoma constitutes 35 per cent. of eye affections. And this large percentage he traces to the small and filthy homes, especially among the Israelites. There, too, *struma* and *trachoma* go hand in hand. In New York City and Brooklyn, estimated from the reports of the eye and ear hospitals of these cities during the past ten years, trachoma constitutes five per cent. of the cases of eye disease.

If I deny the existence of a bacterium in the trachoma tissue, it is still very probable that *micrococci* are the real *provokers* of the contagion, and that these should be sought in the secretion, and not in the conjunctival tissues; and, further, that a particular diathesis, and climatic and hygienic conditions, also play a very significant part in the production of this serious disease.

During the past few years the question of trachoma has been very freely ventilated, and yet, despite the prodigious amount of scientific investigation devoted to the subject, opinions are still far from being unanimous in regard to the nature of the process. By some it is maintained that in trachoma we have to do with a simple inflammatory process; while others believe that it is an inflammation with new formations, to be considered as a disease *sui generis*, with a specific course.

In order to understand the development of the structures which are considered characteristic of trachoma, it will be desirable to recall the normal condition of the human conjunctiva, and I may be excused for briefly referring to it. In the fresh state, the conjunctiva is of a delicate pink color, varying in thickness according to the part which it covers—*i. e.*, from the margin of the lid, backward, it increases in thickness, again becoming attenuated where it is reflected upon the globe; the increase in thickness being

¹ *Græfe's Arch. f. Ophthalm.*, Bd. xxix, 1883, p. 56.

referable to the development of adenoid tissue. The conjunctival surface is not smooth; it is traversed everywhere by furrows which vary in depth, and cross each other in such a manner as to present the picture of a continuous network when viewed from the surface. These are the so-called papillæ or papilliform elevations. But this papillary condition of the surface only manifests itself to the unaided eye at that part of the conjunctiva which extends from the point of transition from conjunctiva of the lid to its point of reflection on the eyeball, known as the cul-de-sac.

It is easy to convince one's self of the unevenness of the healthy conjunctival surface, and that this is due to invaginations of its epithelium, and that this is most pronounced in the cul-de-sac. Reich, Sattler, Stieda, Baumgarten, Jacobson, Jun., Mandelstamm, Ræhlmann, and others agree that this condition is present in the normal conjunctiva; the point of dispute being whether these invaginations are glands or not. Stieda, Sattler, and, quite recently, Ræhlmann have shown that in the new-born there is not a trace of adenoid tissue in the conjunctiva; that beneath the epithelium there is a thin layer of fibrillar connective tissue devoid of cellular deposit; so that in a child of six months, the thickness of the epithelial and fibre-layer together should not exceed 0.05 mm.—0.1 mm.¹ In the adult the conjunctiva is 0.2 mm.—0.3 mm. thick, and in the upper third of the tarsal portion and in the cul-de-sac it may attain to a thickness of 0.4 mm.—0.5 mm.²; this increase in thickness being due to the development of adenoid tissue. The most recent writer on trachoma, Ræhlmann, maintains that the possibility of the development of this disease depends upon the existence of the adenoid layer, the first indication of which he found in the conjunctiva of a child of two months.

Bruch was the first writer to describe lymph follicles in

¹ Ræhlmann: *Gräfe's Archiv für Ophthal.*, Bd. xxix., Abth. ii., 1883, p. 74.

² *Ibid.*

the conjunctiva of the inferior eyelid of the ox.¹ Stromeyer² described follicles in the conjunctiva of domestic and wild animals, and he spoke of them as pathological products. Henle³ calls them trachoma glands. Krause⁴ held the lymph follicle which he found in the conjunctiva of the rabbit, fox, and birds, to be physiological formations, and considered them identical with the solitary lymph follicle in Peyer's patches in the intestinal canal. Kleinschmidt⁵ and Huguenin⁶ found such follicles in the conjunctiva of man. According to the observations of Waldeyer, Sattler, and Ræhlmann, lymph follicles are not present in the normal conjunctiva. Baumgarten, on the other hand, maintains that lymph follicles are also met with in the normal conjunctiva, but his evidence is not convincing. Goldzieher⁷ has recently published some observations on the occurrence of lymphoid growths in the conjunctiva, from which he concludes that lymph follicles are normal constituents of the conjunctiva; but Goldzieher, it seems to us, fails to sustain his argument against Waldeyer and Sattler. Now, if the follicle be a pathological product in the conjunctiva of man, what proof have we of its presence as a physiological formation in animals. A few years ago when I occupied myself with the study of the conjunctiva of pigs, birds, and rabbits, I was not successful in demonstrating the presence of follicles in every instance, even after a very careful search and with the assistance of others more experienced than myself, and I have since come to believe that the presence of this formation in the conjunctiva is directly traceable to the

¹ Bruch: *Zeitschrift für Wissenschaftliche Zoologie*, Bd. iv., p. 297.

² Stromeyer: "Beiträge zur Lehre von der granulösen Augenkrankheit."—*Deutsche Klinik*, Heft 25, 1859.

³ Henle: "Eingeweidelehre," Bd. ii., p. 732.

⁴ Krause: "Anatomische Untersuchungen," Hannover, 1861, p. 154.

⁵ Kleinschmidt: "Ueber die Drüsen der Conjunctiva."—*Gräfe's Archiv f. Ophthal.*, Bd. ix., Ab. 3, p. 157.

⁶ Huguenin: "Ueber die Trachomdrüsen oder Lymphfollikel der Conjunctiva," Zürich, 1865.

⁷ Goldzieher: *Hirschberg's Centralblatt f. Augenheilk.*, Sep., 1882.

manner in which these animals are cared for, and that in them as well as in man it is a pathological product. It is at least found chiefly among such animals as rabbits and pigs, which are herded and come in bodily contact, whereby opportunity is offered for the spreading of the disease through infection and direct transfer, while in birds and cats it is seldom met with.

Synonyms : *Granular conjunctivitis*, which seems to be the most appropriate term to apply to this condition is also known as *trachoma*, *ophthalmia trachomatosa*, *granulations of the eye-lids*, *ophthalmia Ægyptica*, *O. militaris*, *O. bellica*, *O. des armées*, *O. contagiosa*, and the modern addition, *conjunctivitis follicularis*. In its etymological sense, *trachoma* (from *τραχῶμα*, a roughness) can be applied to any of the diseases of the conjunctiva which render the surface of the latter uneven. In view, therefore, of the follicular and granular processes being classed together, and as only a certain percentage of these cases result in retractions of the palpebral conjunctiva, the term *trachoma* would apply more appropriately to them, but this would not be so readily understood as the designation, *conjunctivitis granulosa in stadio cicatriceo*.

When we examine the text-books on ophthalmology and ophthalmological journal literature, we are perplexed by the laxity in regard to the definition of *trachoma* from a clinical standpoint. One author designates as "*trachoma*" what another describes as "*follicular catarrh*." Schweigger¹ describes as "*trachoma granule*" an accumulation, immediately under the epithelium, of lymph-cells without, as a rule, any enveloping capsule of connective tissue. Arlt² considers *trachoma* identical with the chronic blennorrhœa of the conjunctiva in *ophthalmia Ægyptica*, *militaris*, *contagiosa*, and "*granulations*." Others speak of

¹ Schweigger: Text-book. Translated by Porter Farley, M.D., p. 276.

² Arlt: "Klin. Darstellung der Krankheit des Auges," 1881.

granulations when they have to do with so-called "follicular formations," which they designate as "follicles" or "granulations." Others, again, regard granulations as papillary proliferations. Sæmisch¹ considers the so-called trachoma granule as distinct from follicles as well as proliferated papillæ.

A large number of the older writers regarded the trachoma follicle as a normal, a physiological formation: Krause,² Huguenin,³ Frey,⁴ Hessling,⁵ and Kleinschmidt.⁶ More recent writers, among whom may be mentioned Sæmisch and De Wecker, deny that follicles occur in true trachoma. On the other hand, a great number of most competent observers regard the follicle as the basis of trachoma: Decondé,⁷ Bendz,⁸ Stromeyer,⁹ Blumberg,¹⁰ Horner,¹¹ and others. Again, regarding the nature and structure of the trachoma follicle, opinions are very divergent; some writers holding that the trachoma follicle is identical with the closed follicle of the intestine, and consists of a glandular formation with a closed enveloping membrane: Henle,¹² Stromeyer.¹³ On the other hand, Mandelstamm,¹⁴ Remy,¹⁵ Schweigger,¹⁶ De Wecker,¹⁷

¹ Græfe und Sæmisch: "Handbuch der gesam. Augenheilkunde," Chap. iii.

² Krause: "Anat. Untersuchungen," Hannover, 1861, p. 154.

³ Huguenin: "Ueber die Trachomdrüsen oder Lymphfollicle der Conjunctiva," Zürich, 1865.

⁴ Frey: Handbuch, p. 695.

⁵ Hessling: "Grundzüge der Gewebslehre," Leipzig, 1866, p. 220.

⁶ Kleinschmidt: *Græfe's Archiv f. Ophthalm.*, Bd. ix., 3, p. 157.

⁷ Decondé: *Annales de la Société de Médecine de Gand*, Juin, 1840, p. 122.

⁸ Bendz: *Compte-rendu Congrès d'Ophthalmologie*, Paris, 1858, p. 236.

⁹ Stromeyer: *Deutsche Klinik*, 1859, Bd. xi., p. 246.

¹⁰ Blumberg: *Græfe's Archiv f. Ophthalm.*, Bd. xv., 1, p. 142.

¹¹ F. Horner: *Die Krankheiten des Auges im Kindesalter* in Gerhardt's Handbuch der Kinderkrankheiten. Bd. v. Abth. 2. p. 305.

¹² Henle: *Zeitschrift f. ration. Med.*, Bd. viii., p. 227.

¹³ Stromeyer: *Deutsche Klinik*, 1859, Bd. xi., p. 246.

¹⁴ Mandelstamm: *Græfe's Archiv f. Ophthalm.*, Bd. xxvii., 3, p. 106.

¹⁵ Remy:

¹⁶ Schweigger: *Loc. cit.*

¹⁷ De Wecker: Text-book. Translated by L. Forbes, M.D., p. 82.

and others declare that the trachoma follicle has no enveloping membrane. Sattler¹ objects to the view held by Sæmisch, regarding the new-formation of lymph follicles in the conjunctiva, in his so-called follicular conjunctivitis, on the ground that it is without an analogue in pathological anatomy. Nevertheless, we do find examples of the pathological appearance of follicles in places where they never occur in a normal condition (Virchow and Boëtcher²), and analogous in structure to the follicles of the intestine—*i. e.*, in the liver in leuchæmia; and Birch-Hirschfeld³ alludes to the circumstance that the hyperplastic lymphomata are not infrequently complicated with the development, in the connective tissue of different organs, as the liver, kidney, etc., of small nodes, corresponding in structure to lymph-gland tissue, and that these secondary lymphomata are seen in variola, scarlatina, leuchæmia, and pseudo-leuchæmia.

We see, therefore, a large number of distinguished observers unwilling to agree with one another as to the actual nature of trachoma, and in consequence of this disagreement there can be no certainty in regard to prognosis, and the treatment must be empirical.

THE NATURE OF TRACHOMA.

The writer's observations are based on the examination of forty-seven cases of trachoma. In every case several of the prominences of the conjunctiva were excised, and in several instances the entire conjunctiva was examined after death. In all cases, at first, the epithelial surface was found smooth, not thickened. The adenoid tissue was infiltrated with lymphoid cells, but the latter were not uniformly distributed, but in places it extended deeper into the tissue and was more closely arranged. At first there is a circum-

¹ Sattler : Bericht über die Heidelberger Ophthal. Gesellschaft, 1881, p. 19.

² Virchow and Boëtcher: *Virchow's Archiv*, Bd. xviii., p. 22.

³ F. v. Birch-Hirschfeld : "Lehrbuch d. path. Anatomie," 1877, p. 131.

scribed arrangement of lymphoid cells, as represented in fig. 1,¹ and is then without a limiting membrane. The tissue between the foci of infiltration may be quite normal, or, at most, slightly hyperæmic. As a rule, at an early period of their existence the foci of infiltration have a round contour, and the cells at the periphery are smaller and more closely packed together than in the interior, but there is as yet no true anatomical boundary. Under sufficient power, the interior of the young follicle has a distinct reticulum. It is a framework consisting of abundantly branching pale fibres with gangliform swellings, and in places stellate,² branching points with pale, oval nuclei. At this early stage, therefore, the follicle has an envelope only in the sense that the cells are most closely aggregated at the periphery. At a later period the small cells at the boundary assume an oblong shape, and look like a string of beads; and finally the fibrous boundary of the follicle is formed by the cells at the periphery being drawn out into fibres; however, this fibrous boundary is not always found symmetrically developed, but some part of the circumference is bridged over with small round cells, and frequently the follicle is found to communicate with the surface of the conjunctiva through a breach in the enveloping capsule. The young follicle represents a pretty solid nodule, and cannot be easily emptied of its contents by puncture from the conjunctival surface. Leber,³ on the contrary, maintains the opposite view. As the disease advances, the fate of the follicle will be varied according to the intensity of the inflammation, and its contents may become obliterated or undergo softening.

Frequently the follicles are confluent, and when this con-

¹ I am unable to furnish the wood-cut in time for the printers, but on page 31 of Græfe and Sæmisch's "Handbuch," vol. iv., will be found a similar picture.

² Ræhlmann: *Græfe's Archiv*, Bd. xxix., 2, plate v., fig. 13; also Jacobson, Jr.: *Ibid.*, Bd. xxv., 2, p. 169, plate v., fig. 7.

³ Leber: Bericht der Ophthal. Gesellschaft, Heidelberg, 1878, d. 12.

dition extends over a considerable space, the typical boundary described above will not be found. Sclerosed, thickened vessels, as found by Sattler, in the interior of the follicle are developed into fibrous connective tissue; and he alluded to this as the most important circumstance in the connective-tissue transformation. According to Ræhlmann this transformation into connective tissue as issue of the follicle formation in trachoma is not rare, but he states that another fate awaits the follicle which is the more frequent—*i. e.*, the formation of *follicular ulcers*. When the conjunctival cells undergo mucous degeneration, the conjunctiva assumes a soft, gelatinous condition—the gelatinous (*sulzigen*) trachoma of Stellwag. In recent trachoma there is often a vascular network about the follicle. Iwanow¹ and Mandelstamm² deny the existence of blood-vessels in the interior of the trachoma follicle. According to others it has a few blood-vessels. Blumberg,³ Sattler, Horner, Stellwag, Leber, Jacobson, Jr., and Ræhlmann⁴ have shown that the follicle does contain blood-vessels; and injected eyes of animals prove the existence of blood-vessels. I have repeatedly seen vessels, and quite large ones, in the interior of trachoma follicles—fig. 1. The vessels are generally found just inside the wall of the follicle, but only a few firm capillary vessels project into its interior, and these branches are so small that they are only visible by high power. *In the neighborhood of the follicle blood-vessels are often numerous, but their presence and number will depend upon the stage and duration of the disease.*

Some observers have found the follicle of the conjunctiva surrounded by a lymph-sinus. Frey⁵ and Wolfring⁶ have

¹ Iwanoff : Bericht der Ophthal. Gesellschaft, Heidelberg, 1878, pp. 19 and 21.

² Mandelstamm : *Græfe's Archiv*, Bd. xxvii., p. 106.

³ Blumberg : *Græfe's Archiv*, Bd. xv., p. 143.

⁴ Ræhlmann : *Græfe's Archiv*, Bd. xxix., plate iv., fig. 7.

⁵ Frey : *Virchow's Archiv*, Bd. xxvi.

⁶ Wolfring : *Græfe's Archiv*, xiv., 3, p. 181.

described and pictured lymph-vessels in the periphery of the follicle of dogs; and C. Langer¹ has shown in injected preparations, that the follicle is in intimate relationship to the roots of the veins, in that the follicular substance is disposed about these roots.

When the follicles are isolated the tissue-changes are generally limited to the site of the follicle and its immediate vicinity, and the interlying tissue may be free from changes. But generally we have to do with various conditions of catarrh, and these inflammatory changes take place in the surrounding tissue and complicate the process.

Ulceration and cicatricial formations are a more frequent issue of the follicular conjunctival inflammation than induration through new connective-tissue formation, and the two processes generally occur together—ulceration and cicatricial formation on the surface, and connective-tissue sclerosis in the deeper parts. We have also analogous results in inflammation of other mucous tissues, *i. e.*, throat, mouth, intestines, and vagina. The scars which develop on the surface of the conjunctiva are frequently radiate, and sometimes pigmented. As a consequence of the connective-tissue formation in the deeper parts of the conjunctival membrane, the surface of the latter assumes a characteristic appearance over all that portion previously occupied by the follicles; then we see a cicatricial surface with thin epithelial covering, and the gland and epithelium are so far affected as to surrender their power to act as physiological organs. And thus by ulceration of the follicles and the formation of connective tissue in and about the follicles the entire adenoid tissue invaded by the follicular formations is destroyed. So long as the adenoid tissue remains uninvaded, it serves a useful purpose in preserving a certain degree of softness to the conjunctiva; but when its tissue is destroyed in the

¹ C. Langer: *Wiener med. Jahrbücher*, 1878, p. 336.

manner just referred to, we have a hard, irregular, unyielding, dry scar surface. This is of course the extreme result of the trachoma process, and while these changes may be brought about in a few months in acute cases of the disease, in the majority of instances years are required for the chronic form to reach the same. In chronic trachoma, the follicles are at first less dense, but aggregated in isolated heaps, and as some of these follicles are obliterated, others take their places; and so the creation of new follicles and connective-tissue formations and sclerosis goes on, so that in the chronic cases the latter changes attain to an unusual degree. The action of jequirity finds a partial explanation in the assumption that the existing follicles are destroyed, and the further development of others prevented, by the serous infiltration of the conjunctival tissue which it occasions. At least we can explain the occasional enormous thickening of the conjunctiva by the continuance of the connective-tissue formation about the new and old follicles, the latter being crowded into the tissue by the new growths, the connective-tissue formation going on, if not arrested by natural or artificial agencies, so long as adenoid tissue remains. I do not mean to maintain that trachoma produces these extreme changes in the whole conjunctiva in every instance, even when the disease is left to itself. The most common issue, when the disease is appropriately treated, is that the trachoma process is confined to a few places in the conjunctiva, and when the stage of scar formations is reached, the disease ends. In the great majority of cases, however, the process goes on.

The hypertrophic cock's-comb-like fold of the cul-de-sac has recently been classed by Stellwag¹ among the amyloid tumors. He maintains that his gelatinous trachoma (*sulziges Trachom*) is identical with amyloid tumors,—i. e., that

¹ Stellwag von Carion: "Abhandlungen aus dem Gebiete der prak. Augenheilkunde," 1882. Published by Braumüller, in Vienna.

the latter proceed from the former. He defines amyloid tumors as polypoid swellings; that they are partly clotted masses which, in later stages of the process, always rest upon a cicatricial retracted base or upon an actual pedicle, and, as a rule, spring from the semilunar fold or caruncle. In support of his assumption that these amyloid tumors proceed from trachoma, Stellwag adduces that he saw them "appear and grow on conjunctivas which were unquestionably the seat of trachoma." But this is certainly no proof that they owe their existence to trachoma, and more substantial evidence is necessary to establish the etiological connection. Kubli¹ observed in a series of thirty cases of these tumors in the conjunctiva, fourteen in which antecedent or accompanying trachoma could be excluded; so we see these amyloid tumors do occur independently of trachoma.

The adenoid, epithelial invaginations of the conjunctiva in trachoma were first described by Berlin and Iwanow, and declared by them to be new growths and pathognomonic of trachoma. It is generally conceded that these structures exist, but respecting their significance opinions diverge. Reich², de Vincentis³, Ciaccio⁴, and recently Baumgarten, have shown that these glands of Berlin and Iwanow are physiological structures.

At birth no adenoid tissue exists in the human conjunctiva; it develops in old age. Stieda⁵, Sattler⁶, Waldeyer⁷, deny that glands exist in the human conjunctiva, and refer these formations to invaginations of the epithelial surface at the base of the furrows on the surface of

¹ Kubli: *Archives of Ophthalm.*, 1882, vol. xi., No. 2, p. 167.

² Reich: *Græfe's Archiv f. Oph.*, Bd. xxi., p. 1.

³ De Vincentis: *Nagel's Jahresbericht*, Bd. iv., p. 247.

⁴ Ciaccio: Quoted by Henle in his "Handbuch der Anatomie des Menschen," Bd. ii, p. 731.

⁵ Stieda: *Archiv f. mikr. Anatomie*, Bd. iii., p. 357.

⁶ Sattler: *Græfe's Arch. f. Oph.*, Bd. xxiii., 4, p. 1.

⁷ Waldeyer: *Græfe u. Sæmisch*, "Handbuch," Bd. i., p. 240.

the conjunctiva. I have never found actual tubular glands in the human conjunctiva; but if we regard the loop-like invaginations of the epithelium as glands, then we may admit the existence of Stieda's tubular glands; then, also, we might with equal justice call the epithelial furrows glandular organs; if not, then the invaginations are just as little to be regarded as glands as the furrows themselves, whose complete analogue they represent. Jacobson¹ and, quite recently, Ræhlmann² are also of this opinion. We must show that longitudinal as well as transverse sections of the conjunctiva show round sections of such blind sacs, which may be mistaken for the lumens of glands. Mandelstamm³ describes tubular glands which run more or less parallel to the surface of the conjunctiva. But are these not transverse instead of longitudinal sections?

The histological structure of Sæmisch's trachoma granule (Græfe and Sæmisch's "*Handbuch d. Augenheilkunde*," Bd. iv., fig. 2, p. 31) is not distinguishable from proliferated papillæ, and there is no justification for designating these structures as having specific qualities. The greater the proliferation of the papillæ the greater will be the number of these so-called trachoma glands. Now in trachoma these glands, originally running vertically to the surface of the conjunctiva, may, in consequence of the swelling of the parenchyma of the mucous membrane, be pushed out of their original position and extend diagonally to the surface; then, of course, transverse sections would show round sections of these loops or pouches. The analogue of this condition is found in the intestine. Ziegler⁴ has shown that in the mucosa of the intestine the glands of Lieber-

¹ Jacobson, Jun; *Græfe's Archiv f. Oph.*, Bd. xxv., 2, p. 139.

² E. Ræhlmann; *Græfe's Archiv f. Oph.*, Bd. xxix., 2, p. 113.

³ Mandelstamm; *Græfe's Arch. f. Oph.*, Bd. xv.

⁴ Ziegler; "*Lehrbuch der path. Anatomie*," Jena, 1881, pp. 652-655. See also Cornil and Ranvier: "*Manual d' Histologie Pathologique*," vol. iii., p. 828.

kühn, in the neighborhood of Peyer's patches, which run perpendicularly to the surface of the mucous membrane, in consequence of infiltration and swelling of the follicles in abdominal typhus are forced out of place, so that in vertical sections of the membrane round sections of the glands are furnished. Now, if these so-called trachoma glands are the analogues of the epithelial fissures and invaginations which occur in the normal condition, then they cannot be pathological new-formations. Alongside of these invaginations, in trachoma, numerous actual interspaces sometimes occur in the conjunctiva, which are new-formations in the sense that by the swelling of the tissue the conjunctiva is folded in places. Now if ulceration of the apposed surfaces of the folds of the conjunctiva take place and in places grow together (fig. 4), the furrow may become constricted, and the development of partly communicating blind sacs give rise to the formation of cysts,¹ and in consequence of this ulcerative process the walls of the interspaces partly or wholly grow together, and in that way gland-like divisions occur in them (Mandelstamm). This tendency to cyst-formation is evidently accidental and not characteristic of the trachoma process; they are said to occur also in chronic blennorrhœa (Jacobson, Jun.). They nearly always occur at a late period of the disease. These cysts contain, so long as the epithelium is preserved, soft, tallow-like masses in which are epithelial cells, the latter being in places hyaline. Later the cysts contain a yellowish-white, pus-like fluid with few cellular elements, and of which they are readily emptied. This is a degenerative process; but sometimes a diametrically opposite condition obtains—*i. e.*, proliferation of the conjunctival epithelium; not a general uniform increase of the epithelial cells, but a localized proliferation,

¹ Iwanoff: Bericht der Heidelberger oph. Gesellschaft, 1878, p. 18, figs. 3 and 4.

giving rise to inequality of the surface. In regard to the proliferation of the epithelium inward into the tissue of the conjunctiva, which is said to be more frequent than the opposite condition just referred to, although I have seen it I can add nothing new from personal observation. Ræhlmann¹ refers this condition to ancient cases of trachoma in the regenerative stage, where defects have occurred in the surface of the conjunctiva, and these defects occur principally at those places where follicles have ruptured; he, therefore, refers those solid epithelial ingrowths to regenerative proliferation of the epithelium to cover loss of substance after ulceration and excoriation.

So far we have sketched follicular and trachomatous conjunctivitis as two conditions, but we have mainly tried to disprove certain propositions without indicating the true pathogenesis of either disease.

Actual trachoma bodies certainly do in rare instances disappear spontaneously; and such cases have undoubtedly been responsible for the confusion which exists in regard to trachoma, and have given rise to the assertion that special forms of the disease exist. But we should never end if we attempted to enumerate all the classifications which have been offered regarding granular conjunctivitis.

Sæmisch,² de Wecker,³ and Preuss⁴ consider trachoma-granulations as new-formations of a specific character, completely distinguishable on the one hand from true follicles, and on the other hand from papillary proliferations. Sæmisch considers the closed follicle as the pathological basis of "follicular catarrh." This is contrary to the experience of others, and an examination of the sections which I have obtained from conjunctivas in different stages of the

¹ Ræhlmann: *Græfe's Archiv f. Oph.*, Bd. xxix., 2, p. 130.

² Græfe u. Sæmisch: "Handbuch der Augenheilkunde," Bd. iv.

³ De Wecker: Text-book.

⁴ Preuss: *Berliner klin. Wochenschrift*, 1869, Nos. 42, 43.

trachoma process, would contradict this proposition, and show that the "*follicle*" is a *very faithful attendant of trachoma*. That which has been denominated follicle, both in trachoma and follicular catarrh, is an accumulation of lymphoid cells of a circular or oval, and sometimes irregular shape. We have found these structures a pretty constant product in all forms of trachoma. This means that the character of the conjunctival affection, in the one case innocent, in the other serious, does not depend upon the presence of the follicles. Just as the diffuse infiltration of lymph cells in the tissue of the conjunctiva is only a product of inflammation, so is the follicle due to a like cause; its further history depending on various accessory circumstances, such as intensity and duration of the inflammation and the power of resistance in the tissues, the presence or absence of the follicle having nothing in itself characteristic of the disease. The arrangement of the lymphoid cells into clusters or follicles is a peculiar circumstance for which I know no satisfactory explanation. There is certainly no justification upon pathologico-anatomical grounds for distinguishing trachoma from follicular catarrh, and inasmuch as the majority of histologists agree that the follicle does not exist in the normal human conjunctiva, and as we have seen that no other anatomical condition is characteristic of trachoma except the follicle, we may, with good reason, define trachoma as a follicular disease.

The mixed trachoma of Stellwag is nothing more than a transition stage; or, as Schmidt-Rimpler¹ says, there exists only a quantitative, no qualitative, difference between follicular catarrh and trachoma.

It is difficult to ^{reconcile}~~reconcile~~ the statement of Sæmisch in regard to the differentiation of the follicle from papillæ. This writer² furnishes a drawing of the "trachoma granule,"

¹ Schmidt-Rimpler: *Nagel's Jahresbericht* Bd. vi., p. 211.

² Græfe und Sæmisch: "Handbuch der Augenheilkunde," Bd. iv., 2, p. 42.

and says that it is distinguished from papillæ in that it is a prominence of the mucous membrane, the interior of which is infiltrated with lymphoid cells; and from the follicle in that the latter is a roundish, semicircular structure, sharply circumscribed beneath the level of the conjunctiva. But he says, although the histological elements of the "granulation" and those of the swelled papillæ may be classed alike, not alone are form and appearance of the prominences in each case distinguishable the one from the other, but that the structure—the formation—of the granulation is essentially different from that of the papillæ. *L. c.* p. 45. There is, then, according to Sæmisch, a specific trachoma granule. I have never been able to confirm this proposition. In those cases in which portions of the conjunctiva were excised, which microscopically presented the appearance described by Sæmisch, of a round, grayish-red prominence, especially in the region of the posterior fold of the conjunctiva, they were found microscopically to consist either of proliferated papillæ which had coalesced or rather grown together, or of follicles.

There is a vesicular formation on the conjunctival surface which some writers have described as "vesicular granulations," and which has frequently been stated to be premonitory of granular conjunctivitis. Sæmisch aptly describes them as "small, semi-globular, nearly transparent prominences, not quite half the size of a pin's head, which occur most frequently on the conjunctiva palpebræ inferioris, between the posterior fold of the conjunctiva and the free border of the lid, and principally toward the external commissure." These formations are also frequently seen beneath the upper lid, near the external commissure, as an isolated cluster of small vesicular bodies surrounded by swelled, red conjunctiva, the rest of the conjunctiva being apparently normal or but slightly hyperæmic, and we know

that this condition may remain unchanged for a very long time, and without giving rise to any marked symptoms. These vesicles are generally produced by ectasia or a lifting up by a watery fluid of the epithelium, and sometimes the superficial layers of the conjunctiva. If you puncture these bodies with a needle, a clear fluid escapes, and the vesicle collapses. Sælberg Wells speaks of a vesicular condition which he describes as having escaped the attention of other authors, and which he says is premonitory of "granular ophthalmia," and that it is due to the enlargement of "pre-existing lymph follicles in the conjunctiva." But this view was held by Burkard Eble already in 1820, and Helling,¹ Gonzée,² and Decondé.³ However, these authors employed the term vesicular granulations to designate "trachoma granules," and they believed that the latter developed from the vessels. If one or more of these bodies, including a portion of the surrounding swelled conjunctiva, are removed with the scissors and hardened in alcohol, you will see in horizontal sections that these bodies are surrounded by a uniformly thick layer of epithelium with small invaginations here and there. Beneath the epithelial layer is proliferated, partly sclerosed connective-tissue, permeated by numerous lacunæ-like lymph-spaces, which are lined with endothelium, and contain a finely granular amorphous mass (Ræhlmann).

Under normal conditions, the tarsal conjunctiva is attached to the tarsus only by a loose connective tissue. In chronic cases, the follicles are collected in heaps, and as some of these deposits disappear new ones develop, and it is just in the chronic cases that connective-tissue formations and sclerosis attain to an extraordinary degree. In

¹ Helling: "Praktisches Handbuch der Augenheilk.," Berlin, 1881. Bd. ii., p. 117.

² Gonzée: "De l'ophthalmie qui regne dans l'armée belge." Bruxelles et Paris, 1842, p. 219.

³ Decondé: "Memoire sur differentes questions qui se rattachent à l'ophthalmie de l'armée." Annales de la Société de Méd, de Gand, Juin, 1840, p. 131.

consequence of progressive follicular formation and associated disappearance of follicles, the adenoid tissue of the conjunctiva is thickened, and later on destroyed; on the other hand, the sclerosis process converts the loose connective tissue which separates the adenoid layer from the so-called cartilage of the lid, into a mass of dense connective tissue which cannot be distinguished from the fibrous framework of the lid. This young connective tissue undergoes sclerosis and cicatricial retraction. The loose tissue between the cartilage and conjunctiva being obliterated, or rather, incorporated with the cartilage, it is easy to understand what would be the mechanical effect of cicatricial contraction of this tissue. This retraction is generally independent of any change in the fibrous framework (cartilage); but of course the latter may, in long-continued cases, also be involved. As a rule, the cicatricial changes begin in the deeper parts of the conjunctiva, and pass thence outward.

The margins of the lids are nearly always involved in the inflammatory process, and an explanation for this independence on the one hand and constant implication on the other is furnished by the condition of the vascular supply in the conjunctiva, which, excepting a few anastomotic branches, is separated from that of the cartilage; but the conjunctival vessels are very intimately connected with the border of the lids.¹ In addition to the conjunctiva palpebrarum, that of the bulbus and the cornea is also involved at some period of the disease; in the latter instance constituting the condition known as pannus corneæ. But in the case of the cornea it is principally the epithelial layer that is involved. This condition is well shown in a drawing by Ivanoff, in Græfe and Sæmisch's vol. iv., p. 188. Here we see a subepithelial infiltration consisting of small round cells, the cornea proper not generally being involved.

¹ See diagrams in Langer's paper: "Ueber die Blutgefäße im Augenlide." *Med. Jahrbücher*, 1878, Heft. 3, p. 333.

TREATMENT.

The presence of granulations in the conjunctiva does not furnish an immunity against other forms of conjunctivitis, and when they accompany the granulations the condition is intensified, because the secretions which in those cases in which the inflammation is absent or slight are eliminated in a great measure by the tears, lodge between the granulations, especially in the cul-de-sacs, and by decomposition furnish another source of irritation and a means of contagion. It is just here that solutions of corrosive sublimate are useful, on account of the astringent properties of the drug, ^{and} for the mechanical effect of removing the secretions. Of course this decomposition implies the presence of bacterial life, because we know that without them decomposition does not take place.

If we examine the methods which have been employed for treating granular conjunctivitis from the earliest time (the disease was known to Hippocrates,) to the present day, we shall see that the efforts of all have been directed toward destroying the granulations, by a multitude of means, which collectively constitute a chapter as confusing as it is elaborate. But it would be an idle waste of time to enumerate all the substances which have been employed to combat this obstinate disease. The diversity of the methods of treatment originated from the different indications which were thought to best meet the requirements of the disease. Let me first speak briefly of caustics. Some surgeons have proposed to meet the indications by having recourse to caustics. To destroy the granulations may be correct enough, but the caustic also destroys parts we do not desire to influence by it at all; *i. e.*, when you destroy the granulations you likewise destroy the conjunctiva, and you can readily anticipate the mischief which will result when the process of repair after this cauterization is effected. There

was a time not so very long ago when the solid stick of argent. nit. was quite freely employed in trachoma, and even to-day we occasionally hear of its being used. Cauteristics may have yielded good results in a few instances when employed with intelligence and prudence, but in an overwhelmingly large majority of the cases in which it was employed for granular conjunctivitis it occasioned a great deal of suffering to the patient, and he was not recompensed by a good result, and pretty generally another condition was substituted which was even more serious than the original trouble.

If you examine sections of trachomatous conjunctivas, you will see that the tissue of the granulations is lymphoid in its nature, and also that the vascularity is generally very pronounced, and it is to the presence of these vessels that we may justly refer the production of the new-formed cells. Astringents, we know, diminish the diameter of capillary vessels. But it is a great desideratum that the action of the astringent should be *continuous*, otherwise we may produce an opposite effect. The great clinician Trousseau said: "When it is desired to bring about atrophy with astringents, their use must be energetic and sustained."

With the announcement of the discovery of micro-organisms in trachoma tissue, came, of course, the suggestion for the employment of parasitocides; and corrosive sublimate, the recognized most effective among these, was naturally seized upon. Sattler employed it in blennorrhœa of the conjunctiva in solution $\frac{1}{20.000}$, but I am not aware that he used it in trachoma. Quite soon after the announcement of Sattler's discovery, I used corrosive sublimate in trachoma as a parasiticide; but as I investigated the subject for myself, and came to the conclusion that there were no bacteria in the trachoma tissue, I still continued to use it, but mainly for its astringent and mechanical effect. The

astringency of corrosive sublimate is indeed very marked when employed in a one-fourth-per-cent. solution. From personal experience in the use of corrosive sublimate in trachoma I cannot furnish any flattering results; but its solutions remain clean and free from micro-organisms, and for this reason are commendable, especially when they have to be used by a certain class of patients who are not over careful with regard to cleanliness. But you will have to watch your patients, because the corrosive sublimate is very irritating to some eyes, even in very weak solutions of $\frac{1}{10.000}$ or $\frac{1}{20.000}$. I think the best way of applying the solution to the conjunctiva is by means of the spray. A few years ago I had the privilege of introducing this means of making applications in conjunctival affections, but there is one point, to which I made no allusion in my paper,¹ and that is, the mechanical effect of the spray in removing secretions from the conjunctiva, which, as I have stated above, is of especial importance in granular conjunctivitis, because of the collection of secretion between the granules and in the cul-de-sac, and further, because patients, when they wash their eyes, do so generally with their eyelids closed.

The sulphate of copper in crystal is perhaps the most popular and generally employed of the astringents in granular conjunctivitis. But the perfunctory way in which it is so universally used in trachoma often aggravates the disease; however, copper, argentum nitr., and subacetate of lead deserve a conspicuous place in the treatment of trachoma, but they require to be used with a great deal of intelligence. Respecting the subacetate of lead, it may be urged that it forms deposits on the conjunctiva and cornea; nevertheless, if employed in a rational manner, and in conformity to the object you wish to attain, the result will be found to be often better than those obtained from copper;

¹ ARCHIVES OF MEDICINE, 1879.

but, on account of the possibility of its forming deposits on the cornea, it is not a remedy which should be given to patients to use for themselves. Of course, I appreciate the fact that many cases must run the gauntlet of a number of remedies.

There is another method of treatment which has undeservedly, I think, been neglected. I refer to *excision* of the cul-de-sac of the conjunctiva in granular conjunctivitis, first practised, I believe, by Richet, and subsequently and more enthusiastically advocated by Galezowski. I have done this operation in eleven cases. But it should be resorted to, I believe, only as a *dernier ressort*. In three of these cases, operated on about five years ago, in which there was pronounced pannus corneæ, the latter condition was favorably influenced by the excision, and to this day no deformity exists—*i. e.*, no entropion.

The excision is done in the following manner : Seize the superior or inferior cul-de-sac, as the case may be, draw it away from the tarsus, and excise the whole length of the cul-de-sac. Thus you *detach the cul-de-sac entire, without touching the tarsus or the conjunctiva bulbi*. Of course, you should not excise the granulations of the tarsus; the cicatrization which would follow the excision of the tarsal conjunctiva would do infinitely more mischief than the granulations themselves; and, then, the granulations on this part are much less rebellious to treatment than are those in the cul-de-sac; indeed, in the few cases in which jequirity did not produce a perfect result, the granulations had disappeared entirely from the tarsal portion, but remained in the cul-de-sac. After the excision you will generally have to employ astringents.

I come now to consider *jequirity ophthalmia*. In the number of the *Annales d'Oculistique* for July and August, 1882, Dr. de Wecker of Paris, directed attention to the cura-

tive virtues, in trachoma, of the Brazilian plant, jequirity. So far as I have been able to ascertain, jequirity is a local term used by the natives of Brazil to designate its longer botanical name *abrus pectorius*. It is a twining woody shrub indigenous to India, but now found in all tropical countries. The plant is mentioned in the Sanskrit medical writings of Susrata, whence we may infer that it has long been employed in India.¹ It is also known as Indian liquorice, Réglisse d'Amerique, Radix abri, and Liane à réglisse. It was introduced into the Bengal pharmacopœia of 1844, and into the pharmacopœia of India of 1868. The seeds, of the size of a small pea, weigh about $2\frac{3}{16}$ gm.; they are glossy, very hard and tough, and of a beautiful bright-red color with a black spot. In India they are used for making chaplets and necklaces, and we occasionally see them used in our own country for ornamental purposes. When the infusion of the root is mixed with an alkaline solution of tartrate of copper, red cuprous oxide is deposited after a short time.

Although it has long since been settled by experimental proof that we do not possess an agent which exercises an action on the trachoma bodies similar to blennorrhœic pus, yet we have found in jequirity one which, by its being controllable, will receive a much wider application.

To de Wecker belongs the great credit of introducing jequirity into ophthalmic practice. The claim of Moura of Brazil was too late to merit more than the remark which de Wecker made respecting that writer's communication—*i. e.*, that his (de Wecker's) presentation of jequirity to the Academy of Sciences, in August, 1882, had exercised a certain emmenagogue effect on his Brazilian confrère.

The directions for preparing the infusion, as given by de Wecker, were to pulverize thirty-two of the berries (about

¹ Pharmacographia: By Friedrich A. Flückiger and Daniel Hanbury.

three grammes by weight) and macerate the product for twenty-four hours in 500 grammes of cold water ; then add 500 grammes of hot water ; filter immediately after the liquid cools. The patient is to bathe the eyes with this lotion three times in the day. If the resulting inflammation is severe this will be enough ; otherwise the bathing must be repeated on the second day, and if necessary even on the third day, the same liquid being used. The patient must remain in a dark room for fifteen days. However, it is not necessary to adhere to these directions. The infusion may be prepared weaker and without the aid of boiling water, and the patient need not remain in a dark room while the applications are being made.

I prepare the infusion as follows : I have generally attended to this myself. The seeds are first deprived of their red husks by cracking them in a clean linen bag. I then grind them into a powder (not necessarily fine) in a small pepper-mill ; then add cold distilled water or glycerine and set aside for five or six hours ; then filter, and the preparation is ready for use. The watery preparation should be fresh, but the glycerine preparation, if kept in a closed vessel, will be safe and useful after several days, or even weeks. The strength of the infusion should vary according to the nature of the case in which it is employed—1 %, 2 %, 3 % ; the 5 % infusion being reserved for those cases in which the changes in the conjunctiva and cornea are advanced, and in which the conjunctiva is dry and degenerative changes have already taken place. This strength may be employed in other cases in which the changes are less pronounced, but we should always proceed with caution. I apply the infusion to the inverted eyelid by means of absorbent cotton wrapped about the end of a match and dipped into the infusion, and repeat it two or three times during the day and then await results. *When the cornea is not involved I*

make a single application of a fresh one-per-cent. infusion and wait thirty-six hours before repeating it or a stronger (two-per-cent.) infusion.

De Wecker¹ advises to generalize the application of the infusion in all the cases of granulations, even the less intense, but he condemns its use for the removal of papillary hypertrophy, such as is produced by chronic purulent ophthalmia; and *where suppuration already exists artificial suppuration must not be superadded.* But there is one circumstance to which de Wecker alludes which should be corrected—*i. e.*, that the cornea is not exposed to any risk during the evolution of jequirity ophthalmia. Abadie² states that he saw both corneæ completely destroyed by jequirity ophthalmia. However, I believe that *we can control the action of the infusion by regulating its strength, by limiting the number of applications, and by taking advantage of the fact that there is a period of incubation, and this I would particularly commend in those cases of trachoma in which the cornea is not affected,* De Wecker stated that purulence was an essential feature of the ophthalmia, but the sooner this error is eradicated the better, because it may lead to the most disastrous results if we persist in our applications of the infusion until purulency is produced. *Neither purulence nor membrane is an essential feature of the inflammation.* In the majority of my fifty-seven cases there was no membrane, and pure purulence existed only in a very few instances.

Of my fifty-seven cases only three were without result; seventeen were partial cures—*i. e.*, the granulations disappeared from the tarsal conjunctiva, but some remained in the cul-de-sac; in two of these cases, subsequent treatment with argent. nit. removed the granulations. Only in one instance was the use of the infusion attended with an un-

¹ De Wecker: *Annales d' Oculistique*, Mai et Juin, 1883, p. 224.

² Abadie: *Annales d' Oculistique*, Mai et Juin, 1882.

favorable result. The patient, a man, æt. twenty-eight, had had trachoma for three years; both corneæ were clear. There was some mucous discharge in the morning on awaking. I treated him during two months, first with argent. nit., and then with copper, but there was no appreciable change. Flushed with the success I had had with my first jequirity case, I determined to try the remedy in this second one. I first applied a 2 % infusion which was ten days old, but it gave rise to very slight reaction, and so I ventured to try a fresh 5 % infusion. This was applied on a Saturday morning at 7 o'clock. The next day at noon the patient's eyelids were œdematous and there was considerable serous chemosis; the discharge from the eye was serous; and the patient complained of severe pain in his forehead and upper incisor teeth; there was also a profuse serous discharge from the nose, and the eyelids were tender to the touch. No further application of the infusion was made. On the third day at 9 A. M. there was a slight thick and stringy discharge of a straw color from both eyes; the lids were swollen and very firm; the chemosis was very pronounced and of a dense red color. At 6 P. M. of the same day there was a patch of diphtheritic membrane about $\frac{1}{4}$ in. square on the ocular conjunctiva near the periphery of the cornea, and the latter was infiltrated. The diphtheritic condition alarmed me, and I at once proceeded to do what I could to avert the disaster which I considered imminent. There was an extensive ulceration of both corneæ; this healed kindly in the left eye, but there remained considerable loss of tissue in the right cornea. Neither corneæ perforated. All the granulations disappeared from the palpebral conjunctiva of both eyes, but many still remained in the cul-de-sac. The patient was subsequently treated with argent. nit., and after five months he passed from treatment without any true granulations. His vision was R. E. $\frac{20}{80}$, L. E. $\frac{20}{80}$. This was the

second case of trachoma which I had treated with jequirity, and it convinced me of two things—*i. e.*, first, that *the infusion should be fresh*; second, that *5 % is entirely too strong to use in any case in which the cornea is not involved*. A distinguished ophthalmologist of this city had a still worse experience with a 5 % infusion in a case in which the cornea was clear—the latter having perforated, healing taking place with adherent leucoma. However, it would be unfair to use these two cases as evidence against the usefulness of jequirity in trachoma even where the cornea is not involved, because I am convinced that the danger may be avoided by following the directions which I shall speak of further on. In the remaining thirty-seven cases the result was complete cure. I mean by this that the granulations disappeared from every part of the conjunctiva; that the pannus, which was pronounced in the majority of the thirty-seven cases, disappeared; and the sight was improved in the majority of the cases from an ability to perceive light only, to vision $\frac{20}{100}$, and in one of these extreme cases the vision was improved after two months to $\frac{20}{40}$, and there is reason to believe that the vision may become even better in time.

These results show that we have in jequirity a remedial agent of decided value, and although it does not always immediately destroy all the granulations, it diminishes, in a very pronounced degree, the pain and photophobia, and has a marked influence in clearing the cornea.

From October, 1882, to January, 1884, Coppez¹ employed jequirity in 164 cases, of which 140 had granulations often complicated with inveterate pannus, which had resisted other means of treatment. Jequirity was especially successful in old trachoma with rebellious pannus—78 cures among 140 cases. The accidents were augmentation of the

¹ M. Coppez (Brussels): *Recueil d' Ophthalmologie*, Février, 1884, p. 67.

opacity of the cornea, or ulceration was even produced of this part ; but Coppez states that renewed application of the infusion always dispersed the corneal trouble. He had seen hypopyon ectropium of inferior lid, erythema of the face and lids ; and, in the case of a young girl with trachoma, pannus and ozæna,—all three troubles disappeared simultaneously.

There is a point of very great importance in the use of jequirity which is in striking contrast to that of inoculation with blennorrhic pus, and that is that with the latter you can inoculate only in case both eyes are affected, because of the danger of communicating the contagion to the fellow eye. *The discharge in pure jequirity ophthalmia does not possess the property of contagion.* I have again and again tried to reproduce the inflammation in jequirity ophthalmia by inoculating (rabbits) the good eye with secretion taken from the eye under jequirity, but always with negative results. Nevertheless we should exercise a great deal of caution when using this remedy in case one eye only is affected, and bear in mind the possibility of the infusion taking on infectious qualities through long exposure to the air. The infusion should on this account be prepared fresh, and *all infusions several days or weeks old should be discarded.* I mention this circumstance because I observed that, in one instance in which the infusion was prepared in the ordinary way and kept on the table for several days, it gave rise when applied to a rabbit's eye to a true infectious disease. But I am not sure that this infectious quality may not have been acquired, during my absence from the laboratory, from contamination of the infusion in some other way than mere contact with the air. However, I consider this fact a strong argument for using *none but fresh infusions.*

The infusion should be applied in such a way that its action will be confined as much as can be to the parts you

wish to influence, for in this manner it does seem that you will be better able to keep it under control.

Menacho¹ (assistant to de Wecker) records three hundred cases which were subject to this treatment during the second half of the year 1883 in Dr. de Wecker's clinique. They advise its use in the following class of cases: 1. Forms of torpid ulcers of cornea, facette ulcers, and principally cicatricial keratitis. 2. Strumous pannus tenuis. 3. In conditions consecutive to parenchymatous keratitis, infiltrations, and sclerosis.

Parisotti and Galezowski² used jequirity in ten cases, but not with the best results. Deneffe³ declared that jequirity is inoperative in pannus; but this statement is completely at variance with facts, for it is just in such cases that jequirity furnishes such brilliant results. There are others who have been unsuccessful with jequirity, but the evidence furnished by de Wecker, Coppez, Terson, Vacher, Gruening, and numerous others, encourages us to expect better things from it.

After a single application of jequirity infusion to the eye, there is no perceptible change for several hours; the phenomena develop at first slowly, and after four or five hours there may be only a slight increase in the flow of tears; after eight hours the hyperæmia may be only slightly pronounced, but after twenty-four to thirty-six hours the eye presents the picture of a pretty intense inflammation. The lids are swelled and matted together, and, in the case of a human being, very painful to the touch. After forty-eight hours the tarsal conjunctiva is generally covered with a more or less adherent whitish or grayish-yellow membrane. The secretion is generally muco-purulent; the palpebral con-

¹ Menacho: Sur les indications thérapeutiques du jequirity dans les affections de la cornée, *Revue d'Oculistique*, Jan., 1884, p. 14.

² Parisotti and Galezowski: *Recueil d'Ophthalmologie*, Jan., 1884, p. 31.

³ Deneffe: *Recueil d'Ophthalmologie*, May, 1883, p. 248.

junctiva is also greatly swelled and firm, and the ocular conjunctiva is frequently, especially in the delicate rabbit, chemotic, and the cornea is nearly always involved in these animals. On the third or fourth day the inflammation begins to recede, and after three or four weeks there remains perhaps a slight opacity of the cornea and some injection of the conjunctiva; but this condition will vary according to the strength of the infusion and the susceptibility of the animal. This is what generally obtains after a single application of the infusion in the rabbit.

THE NATURE OF JEQUIRITY OPHTHALMIA.

At Dr. de Wecker's request, Dr. Sattler of Erlangen undertook a series of experiments for the purpose of determining the nature of jequirity-ophthalmia, and the results of his investigations have been published in the *Klinische Monatsblätter f. Augenheilkunde* for June, 1883, p. 259. Professor Hilger and Dr. Giesmann tried to isolate, chemically, the active principle of the berry, but neither of these gentlemen succeeded in doing so, and so far similar attempts have been equally unsuccessful. Sattler concluded from his experiments that the active agent in the infusion was a particular bacillus, derived from the atmosphere, and that although harmless in itself, its spores developed in the infusion new physiological qualities (*l. c.*, p. 224); in other words, that they were metamorphized from an innocent into a pathogenic bacterium. But such a transformation has not yet been proven, nor does Sattler furnish a demonstration of it. However, Sattler maintained that jequirity ophthalmia was an infectious disease. In order to solve this problem it was necessary to show that a distinct bacterium existed in the infusion, which constantly returns in all infusions of the berry, and it should be found again in the tissues which it infects, and also in the secretions furnished by the latter. It must further be shown that the

infusion is without effect when the bacterium is removed or rendered inactive. Finally, the particular bacterium of the infusion should be transferred to a suitable culture medium, and rendered pure by a series of generations, and when the pure culture is applied to the conjunctiva, it should reproduce the disease. Sattler claims that his experiments justify him in answering these questions affirmatively. He maintains that the infusion contains a great number of bacilli, 0.58 mm. thick, and about 2.5 mm. to 4.5 mm. long, at times motionless, at other times moving about in a very lively way, with oscillatory or rotatory movements. These bacilli are very readily demonstrated in all fresh jequirity infusions, and there are generally other varieties of bacteria; but the bacilli of the size referred to above, are always present in greater numbers than any other forms. We must agree with Sattler so far as the presence of the bacillus is concerned, but in another direction my experiments have led me to views diametrically opposed to those of Sattler—*i. e., jequirity ophthalmia is not a bacterial disease*, and that instead of bacteria being the active agents, they, on the contrary, by giving rise to putrefactive changes, actually destroy the peculiar properties of the infusion. Let us examine briefly the evidence which contradicts Professor Sattler's view respecting the nature of jequirity ophthalmia.

If the inflammation produced by a jequirity infusion be referable to the presence of bacteria in or their action upon the infusion, then when the infusion is prepared in such a manner as to exclude all bacteria, such an infusion should be inoperative. To decide this question, I proceeded as follows: A number of jequirity berries, previously weighed, were placed for twenty minutes in a 0.1 % solution of corrosive sublimate; then they were dried with a cloth which had been kept in the sterilizer at 180° C. for two hours; the red husks were

then removed with the aid of strong pincers previously sterilized by heat, two pincers being used in order to avoid touching the berry with the fingers; the berry was now crushed, or only squeezed, and dropped at once into a sterilized flask containing cold water or glycerine which had been previously subjected to 100° C. in the sterilizer during two hours; the flasks were then stopped with sterilized absorbent cotton-wool, and laid aside, at the temperature of the room, about 68° Fahrenheit, for use after from four to thirty hours. The infusions were in strength $\frac{1}{2}$ %, 1 %, 2 %, 3 %, and 4 %. At the time of use, the selected infusion was examined microscopically for bacteria, and gelatine bouillon (prepared according to Koch's directions) was inoculated with the same infusion, in order to make the test complete. These infusions gave rise to the characteristic inflammation in every instance when applied to the conjunctiva of rabbits and patients who had trachoma, *a distinct period of incubation being observed in every instance*; but microscopic examination of the infusion did not reveal any bacteria, and the gelatine bouillon remained free from bacteria, although it was kept in an incubator at a temperature varying from 34° C. to 36° C. These experiments were repeated a great many times, and in every instance the most rigid precautions were observed to exclude all bacteria. According to Prof. Sattler's proposition, a pure culture of the particular bacillus found in the infusion should reproduce the characteristic inflammation when applied to the conjunctiva of animals which we know to be susceptible to the contagion; but this in my hands failed in every instance. Nor was I ever able to demonstrate the presence of the bacilli in the secretion or in the membrane formed on the conjunctiva, or in the conjunctival tissue itself: Neiser,¹ Salomonson,² and Klein,³

¹ A. Neiser (Breslau), *Fortschritte der Medicin*, No. 3, 1884, page 73.

² Dr. C. S. Salomonson, stud. med. J. Christmas Dirckinck-Holmfeld in Copenhagen: *Ibid.*, No. 3, page 78.

³ Klein (London), *Centralblatt für prakt. Augenheilk.*, 1884, page 55.

have had similar experience. In some instances, the secretions from the inflamed eyes under jequirity did contain micrococci, but this is a common circumstance, as they are also often found under normal conditions.

I did not rely upon filtration for excluding bacteria from the infusion, because if the specific action of the latter were due to the presence of bacteria or to a particular bacillus, or to the latter giving rise to certain changes (chemical) in the infusion, then filtration of the liquid—*i. e.*, through clay—would, if the infusion were still operative, not dispose of the proposition that bacteria were the immediate cause of the inflammation of the eye to which it had given rise, because the infusion may have acquired noxious properties through the previous vital activity of the organism. Here I may mention by way of analogy, that the resulting infection, after inoculation of rabbits with animal tissues in various stages of putrefaction, is just as certain if the putrid substance be previously boiled and thereby deprived of living organisms, since putrefaction must be regarded, in the present state of our knowledge, as impossible without the presence of bacteria; and it is evident that in such cases sepsis was due, directly or indirectly, to the action of bacteria, because even the boiled substances used by Panum and Rosenberger, and the crystalline substance obtained by Bergmann and Schmiedeberg from putrefying beer, and which they termed sulphate of sepsin, had acquired their septic properties through putrefaction—*i. e.*, through the action of bacteria.

However, although the bacterial agency be opposed by very substantial proof, there is no evidence which contradicts the probability that the active principle of the infusion is a *vegetable substance*, and this agent is soluble in water and glycerine, and is destroyed by boiling.

Subcutaneous injections of an infusion of jequirity in rabbits kill these animals, and the death may be quite independent of any bacterial agency. I have convinced myself of this fact by repeated experiments with the infusion prepared under precautions. I should not speak of this circumstance here, but Cornil and Berlioz¹ have recently published the accounts of experiments upon rabbits and other animals, in which they injected a decoction of the berry, subcutaneously; death was produced within thirty-six to sixty hours. At the site of the injection there was an inflammatory œdema of the skin; also slight peritonitis, ecchymoses of mucosa of stomach, and tumefaction of Peyer's patches in the intestines, bacilli being found in large numbers in the blood of the heart, and all the vessels containing a great quantity of live bacteria; furnishing, in brief, the characteristic phenomena of an infectious disease. These gentlemen concluded that the bacteria of jequirity are the sole active principle. But the jequirity infusion generally contains such a variety of bacteria, that the experiments of Cornil and Berlioz only show what may be produced with many other vegetable infusions which are favorable media for certain bacteria. One of their rabbits recovered from a phlegmon and local gangrene determined by subcutaneous injection of a small dose of the decoction; they assert that it acquired immunity against subsequent infection. But in respect to this proposition we may recall Koch's reply to Pasteur's theory respecting immunity against infectious diseases, namely, that although some of the infectious diseases occur in the same animal but once, as a rule, yet no immunity is secured from others by the first attack, and adduces erysipelas, gonorrhœa, intermittent and recurrent fever, as examples familiar to all, and that anthrax not infrequently occurs twice in the same individual.

¹ Cornil et Berlioz: Sur l'empoisonnement par le jequirity. *Comptes Rendus Heb. des Séances de l'Académie des Sciences*, 1883, No. 12, p. 679, and No. 15, p. 806.

